FINAL

MODELING PROTOCOL IN SUPPORT OF A FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

Maricopa Association of Governments

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Nomenclature

AERMET	AERMOD Meteorological Processor
AERMOD	AMS/EPA MODel
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AMS	American Meteorological Society
AZMET	Arizona Meteorological Network
BACM	Best Available Control Measures
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CART	Classification And Regression Tool
CO	Carbon Monoxide
DRI	Desert Research Institute
EC	Elemental Carbon
EGAS	Emission Growth Analysis System
EPA	Environmental Protection Agency
EPS3	Emissions Preprocessor System
FDDA	Four Dimensional Data Assimilation
FORTRAN	FORmula TRANslation
FSL	Forecast Systems Laboratory
IDA	Inventory Data Analyzer
ISCST3	Industrial Source Complex Short Term
LTO	Landings and Take-Offs
MAG	Maricopa Association of Governments
MAGE	Mean Absolute Gross Error
MB	Mean Bias
MCAQD	Maricopa County Air Quality Department
MFB	Mean Fractional Bias
MM5	Mesoscale Meteorological Model
MNB	Mean Normalized Bias
MOBILE6	EPA-approved Onroad Mobile Source Emissions Model
NAAQS	National Ambient Air Quality Standards
NCAR	National Center for Atmospheric Research
NCDC	National Climate Data Center
NEI	National Emission Inventory
NH3	Ammonia
NOx	Oxides of Nitrogen
NWS	National Weather Service
OC	Organic Carbon
OSW	Office of Surface Water
PM-10	Particulate Matter less than or equal to10 microns
PSU	Pennsylvania State University
RVP	Reid Vapor Pressure
SAMSON	Solar and Meteorological Surface Observation Network
SCRAM	Support Centre for Regulatory Air Quality Models

SLAMS	State and Local Air Monitoring Stations
SO2	Sulfur Dioxide
TEOM	Tapered Element Oscillating Microbalance
TSD	Technical Support Document
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel
VOC	Volatile Organic Compounds

1. Overview of Modeling Study

1.1 Background

Under the 1990 Clean Air Act Amendments the Maricopa County nonattainment area was initially classified as Moderate for PM-10 particulate pollution. Because attainment of the particulate standard was not achieved by December 31, 1994, the nonattainment area was reclassified to Serious on June 10, 1996. The new attainment date for Serious nonattainment areas was December 31, 2001.

As the designated Regional Air Quality Planning Agency, the Maricopa Association of Governments (MAG) prepared the "Revised MAG 1999 Serious Area Particulate Plan For PM-10 for the Maricopa County Nonattainment Area." EPA subsequently approved the MAG Plan to meet the particulate matter standards in the Phoenix area (67 FR 48718, published July 25, 2002). As part of the approval, EPA granted the request for an extension of the attainment date to December 31, 2006.

Due to numerous exceedances in November 2005 through March 2006, several monitors in the Maricopa County nonattainment area will not meet the 24-hour PM-10 standard by 2006[1]. Under the Serious Area PM-10 Plan, local cities and towns, Maricopa County, and Arizona Department of Environmental Quality are implementing 77 control measures for the primary sources of airborne particulates. The primary sources of particulate pollution in the nonattainment area are fugitive dust from construction sites, agricultural fields, unpaved parking lots and roads, disturbed vacant lots, and paved roads.

For areas that fail to attain the PM-10 standard by the applicable attainment date, CAA section 189(d) requires that a Five Percent Plan for PM-10 be submitted to EPA within one year of the attainment date. Because the Maricopa nonattainment area will not meet the PM-10 standards by December 31, 2006, MAG must submit a new PM-10 attainment plan by December 31, 2007. The Five Percent Plan must show reductions in PM-10 emissions of five percent per year until attainment is achieved at all monitors.

1.2 Conceptual Model

MAG has conducted an analysis of 24-hour PM-10 data during the period March 2005 through March 2006 in order to develop a conceptual model for the Five Percent Plan for PM-10. Major features of the conceptual model for the Maricopa County nonttainment area are described in this section. A more detailed discussion of the conceptual model is provided in Attachment VI.

PM-10 in the arid Southwest largely consists of coarse particles (i.e. aerodynamic diameter greater than 2.5 microns but less than or equal to 10 microns) which are typically crustal in nature and derive mainly from windblown dust, resuspended road

[1] EPA revoked the annual PM-10 standard on September 21, 2006. Therefore, this document addresses modeling for the 24-hour PM-10 standard only.

dust (from paved and unpaved roads), unpaved parking lots, disturbed vacant land, mining operations, construction, and agricultural activities (e.g., tilling and harvesting, travel on unpaved farm roads). Other components of particulate matter (PM), such as sulfates, nitrates, and organic and elemental carbons (OC and EC), are typically found in the fine fraction of PM (i.e., aerodynamic diameter less than or equal to 2.5 microns), but can also contribute to coarse PM. Previous analyses of PM-2.5 data in the Phoenix area have shown that mobile source exhaust, burning, and industrial sources are important constituents of PM-2.5. EPA designated Maricopa County as an attainment area for PM-2.5 in September 2005. The co-located PM-10 and PM-2.5 monitors at the Durango Complex site indicate that PM-2.5 readings on days with high PM-10 concentrations range from 6 to 15 percent of the PM-10 on high wind days and 14 to 22 percent, on low wind days. Therefore, the PM-10 problem in the Maricopa County nonattainment area is largely attributable to coarse particles, comprised primarily of geologic material.

The first step in understanding PM-10 in the Maricopa County nonattainment area is to identify the important crustal constituents of PM-10. High PM-10 concentrations generally occur in September through March, on days with stagnant or near-stagnant conditions. Due to the lack of wind, the local contribution of PM-10 near the sites that exceed the PM-10 standard is very important. The contribution of specific local sources can be best understood by identifying the potential sources of PM-10 near monitoring sites, assembling meteorological, emissions, and monitoring data, and applying air quality models to evaluate the relationship between PM-10 emissions and concentrations.

To meet the requirements of CAA section 189(d), MAG will prepare a Plan that shows a five percent reduction in emissions per year until attainment of the 24-hour PM-10 standard is achieved at all monitors. Due to the numerous exceedances experienced in 2006, the earliest attainment year that can be achieved is now 2009. The Five Percent Plan will demonstrate through modeling that the 24-hour PM-10 standard will be met at all monitors by December 31, 2009. This will require implementation of additional PM-10 control measures. Legally binding commitments to implement these control measures will be included in the Five Percent Plan submitted to EPA.

As the designated Regional Air Quality Planning Agency, MAG conducts modeling of PM-10 emissions and concentrations and prepares air quality attainment and maintenance plans. This protocol will detail the procedures that will be followed in conducting all aspects of air quality modeling for the Five Percent Plan for PM-10.

1.3 Management Structure and Committees

MAG has responsibilities for regional involvement in a number of planning issues and has established an extensive mechanism for ensuring coordinated policy direction from elected officials, coordinated management and technical input, advice from the appropriate agency staff, as well as direct citizen input. Figure 1-1 illustrates the MAG Policy Structure and Figure 1-2 presents the MAG Committee Structure. All policy committees and formal technical committees follow the Arizona open meeting law, which requires, among other requirements, the posting of meeting notices and agendas at least 24 hours prior to any meeting.

The MAG Regional Council is the governing body of MAG. It is comprised of elected officials from each member agency, two ex-officio members representing the Arizona State Transportation Board, and a representative from the Citizens Transportation Oversight Committee. This composition of elected officials is a reflection of citizen input at the local government level. The MAG Regional Council agenda includes a call to the audience, providing the opportunity for public comments at each monthly meeting.

MAG holds at least one formal public meeting prior to the adoption of any new or update to the nonattainment area plan. Formal public meetings are advertised locally at least 30 days prior to the meeting date and documentation is available for public review during this 30-day period. Draft documents are distributed to appropriate federal, state, and local agencies for review and comment during this period. Comments received are analyzed with a staff response for consideration by the MAG Air Quality Technical Advisory Committee and MAG Regional Council before taking approval action. Documentation of the comments and responses are incorporated into the plan document.

Due to the technical complexity of many MAG programs, committees consisting of professional experts are often needed to assist in program development. The Air Quality Technical Advisory Committee is composed of representatives from eight MAG member agencies, citizens, environmental interests, health interests, the automobile industry, the fuel industry, utilities, public transit, the trucking industry, the rock products industry, construction firms, the housing industry, architecture, agriculture, industry, business, parties to the Air Quality Memorandum of Agreement, and various State and Federal agencies. The role of the Technical Advisory Committee is to review and comment on technical information generated during the planning process and make recommendations to the MAG Management Committee.

1.4 Participating Organizations

The Air Quality Planning Team will provide technical oversight for this project. This team includes staff representatives from the Maricopa Association of Governments (MAG), the Arizona Department of Environmental Quality (ADEQ), the Arizona Department of Transportation (ADOT), and the Maricopa County Air Quality Department (MCAQD). The activities of this working group are directed by a Memorandum of Agreement among the agencies involved (see Attachment III). Representatives of other agencies, including EPA and the U.S. Department of Transportation, will be consulted on technical matters, as needed. The Air Quality Planning Team will meet as necessary during the PM-10 modeling effort. Periodic reports on the status and progress of various phases of the modeling work will be presented at these meetings, and technical issues will be discussed and resolved.

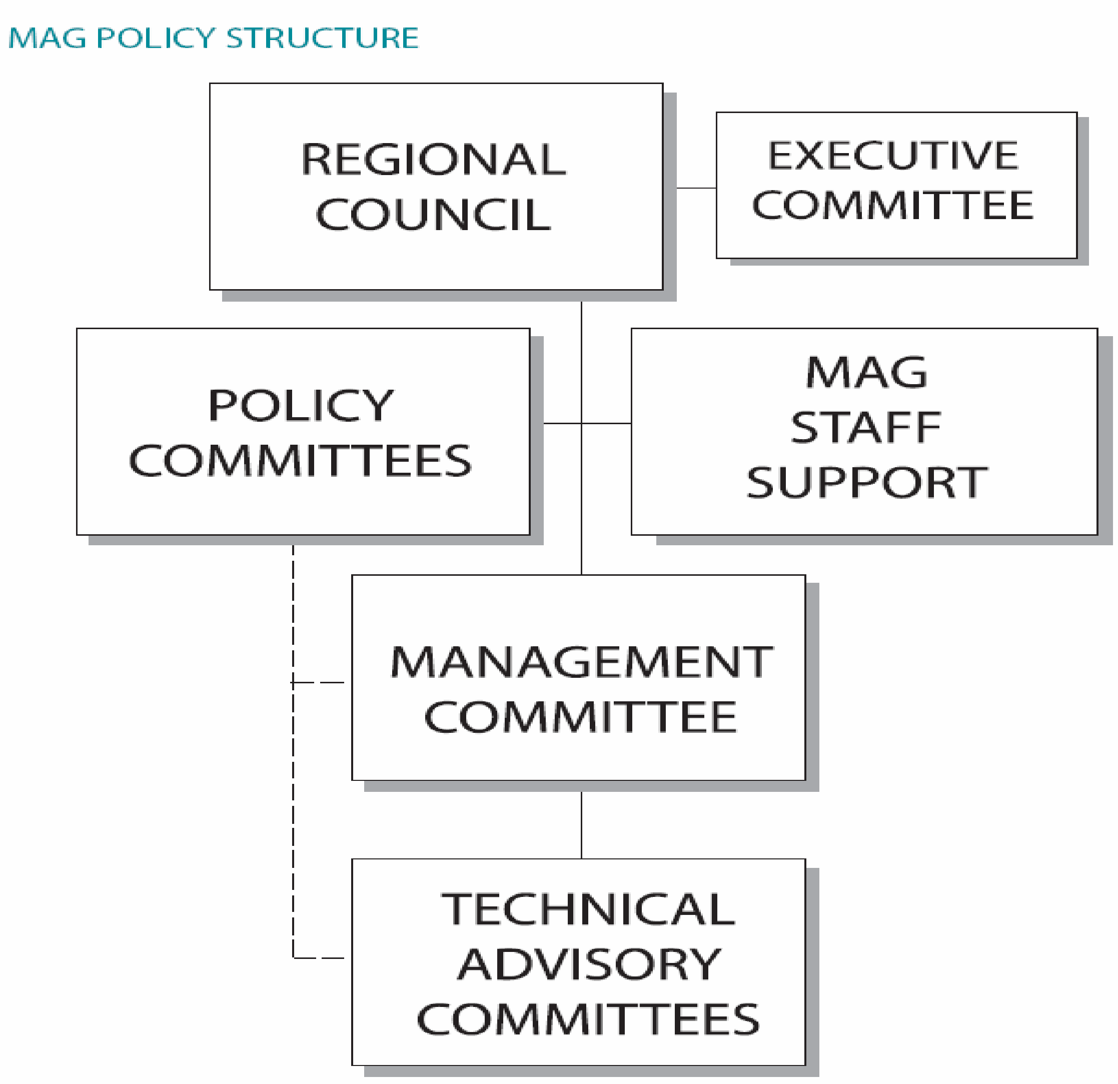

Figure 1-1 MAG Policy Structure

MAG COMMITTEE STRUCTURE

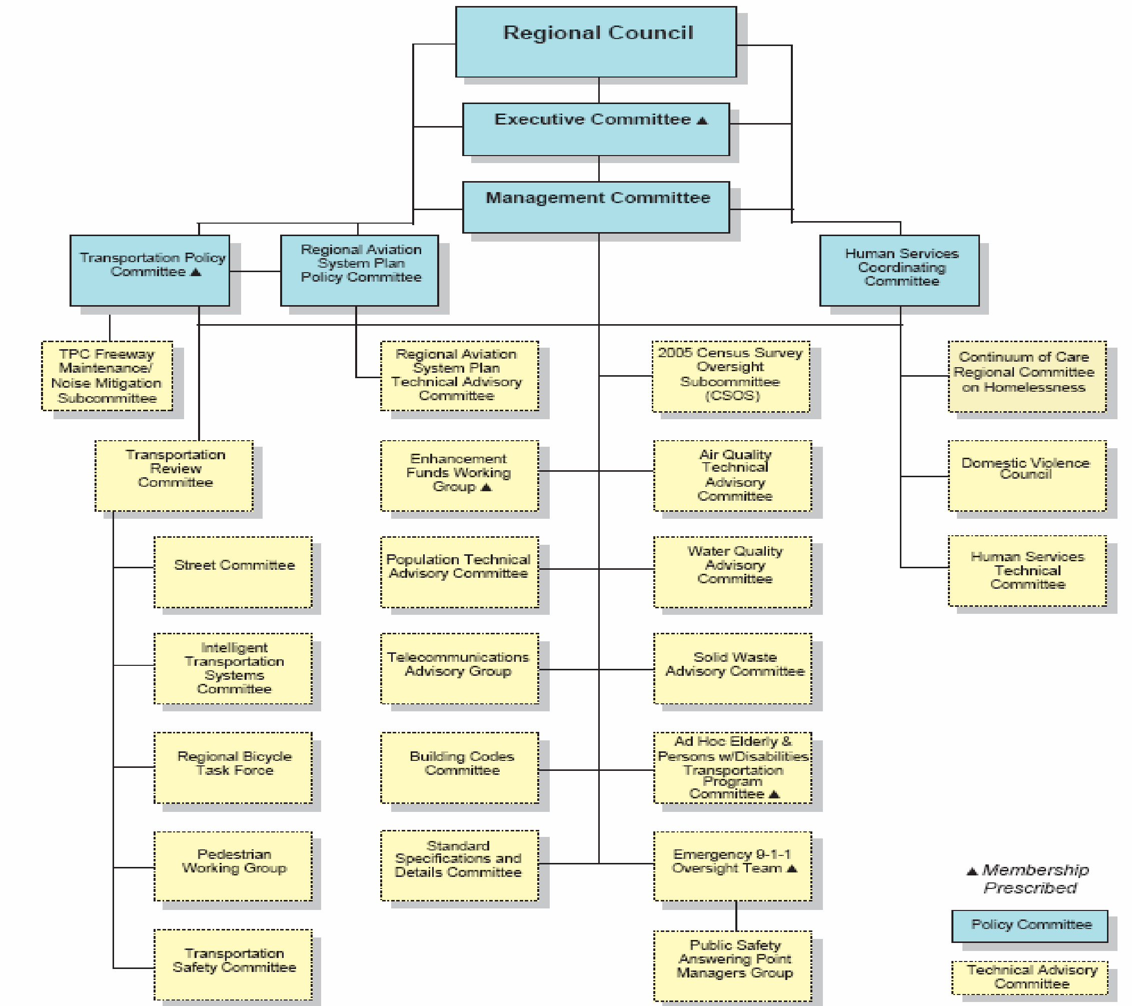

Figure 1-2 MAG Committee Structure

1.5 Schedule

The following modeling tasks will be conducted for the Five Percent Plan for PM-10. The schedule is illustrated in Figure 1-3.

1. **September 2006:** Prepare the protocol describing the purpose, background, and procedures to be followed in modeling for the Five Percent Plan for PM-10.
2. **September 2006:** Assist the Maricopa County Air Quality Department (MCAQD) in preparing the 2005 periodic emissions inventory for PM-10.
3. **October 2006:** Prepare point and area source emissions for 2006 based on the 2005 periodic emissions inventory.
4. **October 2006:** Apply MOBILE6.2 and M6Link to prepare onroad mobile source emissions (for paved and unpaved roads) and the EPA NONROAD model and the MAG Aviation Processor to prepare nonroad mobile source emissions for 2006.
5. **October 2006:** Process area, point, onroad, and nonroad emissions using M6Link to obtain gridded, temporally allocated emissions for design days.
6. **October 2006:** Gather appropriate meteorological data and process with AERMET for input to AERMOD.
7. **December 2006:** Conduct AERMOD performance evaluation for the base case design days.
8. **December 2006:** Prepare 2007 through 2009 base case emissions inventories using appropriate growth factors and existing control measures.
9. **February 2007:** Conduct base case simulations for the attainment year with the AERMOD and proportional rollback models.
10. **July 2007:** Conduct control measure evaluations and model attainment with committed control measures.
11. **September 2007:** Document technical issues and data in the Technical Support Document for the Five Percent Plan for PM-10.

	2006										2007								
PM-10 Modeling Task List	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
1. Finalize modeling protocol							✦												
2. Assist in preparing 2005 periodic emissions inventory							✦												
3. Prepare 2006 point and area source emissions								✦											
4. Prepare 2006 onroad and nonroad mobile source emissions								✦											
5. Process emissions for design days								✦											
6. Prepare meteorological data for AERMOD								✦											
7. Conduct AERMOD performance evaluations										✦									
8. Prepare 2007-2009 base case emissions inventories										✦									
9. Conduct base case simulations for attainment year												✦							
10. Evaluate control measures and model attainment																	✦		
11. Finalize Technical Support Document																			✦

Figure 1-3 Modeling Schedule for the Five Percent Plan for PM-10

2. Air Quality Models

This chapter discusses the selection of the air quality models to be applied in demonstrating attainment of the PM-10 standard for the Five Percent Plan. Domain selection, design day selection, and ambient air quality monitoring data are also discussed.

2.1 Selection of Air Quality Models

The U.S. Environmental Protection Agency (EPA) suggests a number of alternative models for PM-10 application. In general, the suitability of the model is based on the following factors:

- The meteorological and topographic complexities of the area
- The level of detail and accuracy needed for the analysis
- The technical competence of those undertaking such simulation modeling.
- The resources available
- The detail and accuracy of the database, e.g., emissions inventory, meteorological data, and monitoring data

EPA PM-10 State Implementation Plan (SIP) development guidelines encourage application of dispersion modeling when it is determined to be the most suitable approach. Attachment IV provides EPA guidelines on air quality modeling.

Air quality model selection and application are mainly dependent upon data requirements, the availability of emissions, meteorology, and air quality data, and the validity of the representation of PM-10 concentrations[1]. There are three fundamental modeling approaches: receptor chemical mass balance, receptor speciated rollback, and grid-based dispersion modeling with day specific data. MAG is proposing that two different modeling approaches be applied in the Five Percent Plan, a grid-based dispersion model and receptor speciated rollback.

The grid-based dispersion model is proposed for application to the area analyzed as part of the Salt River Area PM-10 Study conducted by the Arizona Department of Environmental Quality (ADEQ)[2]. A dispersion model is appropriate because the meteorology and terrain in the Salt River Area are complex and there is a large and diverse set of sources contributing to elevated PM-10 concentrations. In addition, MAG is currently conducting a PM-10 Source Attribution and Deposition Study that includes saturation monitoring in the Salt River Study area. The objective of the MAG Study is to better define the sources contributing to the high monitored PM-10 values in the area, especially during stagnant weather conditions. This will improve inputs to the dispersion model and enable identification of cost-effective measures to reduce PM-10 concentrations.

MAG is recommending that receptor speciated rollback be applied for one design day and monitoring site located outside the Salt River Study Area. In this case a more simplistic rollback approach is appropriate, because there was only one exceedance and there are a limited number of sources surrounding the monitor. The design day to be modeled with rollback had high wind (01/24/06) conditions. The next two sections discuss in more detail the rationale for selection of the AERMOD and rollback models.

2.1.1 AERMOD

Due to the wide variety of sources contributing to high PM-10 concentrations in the Salt River Study Area[2], receptor speciated rollback does not provide enough information upon which to base an attainment demonstration, since many source types cannot be distinguished. The Chemical Mass Balance (CMB) model cannot discriminate between soil-entrained dust from construction activities versus soil-entrained dust from vehicles or wind erosion. Based on a review of EPA guidelines, it appears that the grid-based dispersion model, AERMOD, is the most suitable for evaluating PM-10 exceedances in the Salt River Study Area.

AERMOD (AMS/EPA Regulatory Model) is a steady-state Gaussian plume dispersion model that assesses pollutant concentrations from a variety of sources. Sources and receptors located in complex terrain can be simulated considering the transport and dispersion from multiple point, area and/or volume sources based on characterization of the boundary layer. Mobile sources are considered as multiple area or volume sources joined together[5].

EPA adopted AERMOD as a regulatory model on December 9, 2005, as a replacement for ISCST3. Compared with ISCST3, AERMOD contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed is less than 1 m/s[1][8]. This is a desirable feature, since one of the design days, December 12, 2005, is characterized by stagnant conditions.

AERMOD has a proven track record in modeling various pollutants, including PM-10. Previous research by Desert Research Institute has shown that the AERMOD predecessor, ISCST3, performed well in assessing the local PM-10 source attribution in the Clark County, Nevada[4].

AERMOD contains improved algorithms for dealing with low wind speed (near calm) conditions. No other model has been found to perform better for modeling area source fugitive dust. This is important because fugitive dust is a major contributor to high PM-10 levels in the Salt River Study Area and throughout the remaining nonattainment area[3].

MAG has also selected AERMOD based on its past usage[2], public familiarity, and the resources available[1]. The general characteristics that make AERMOD suitable for application in the Salt River Study Area include:

- It is capable of handling a wide range of regulatory applications in all types of terrain
- If fugitive dust emissions are properly specified, gravitational settling and dry deposition are handled well

- Low-level emission sources, such as area sources, can be modified to produce a more realistic urban dispersion
- The minimum layer depth can be changed to calculate the effective parameters for all dispersion settings

Despite its advantages for PM-10 modeling, AERMOD:

- Does not explicitly address the urban transport of PM-10
- Has no algorithm to handle secondary PM-10 formation
- Requires source-receptor locations to be well defined
- Can be data-intensive (e.g., microinventories, meteorology)

These limitations should not inhibit the successful application of AERMOD for the Salt River Study Area. The quantification of long distance and intra-urban transport will be addressed in defining the boundary conditions for AERMOD modeling. Saturation monitoring to be performed for the MAG PM-10 Source Attribution and Deposition Study will assist in quantifying the urban transport levels of PM-10 for the Salt River Study Area during stagnant conditions. PM-10 monitoring in pristine areas of the state (e.g., Organ Pipe National Monument) will provide the basis to quantify the rural background contribution. These efforts should ameliorate the urban transport deficiency associated with application of AERMOD. ADEQ has already conducted analyses of the urban transport and background levels contributing to high PM-10 levels in the Salt River Study Area in 2002. (See ADEQ comments in ATTACHMENT VII).

AERMOD's inability to handle formation of secondary PM-10 is not a drawback for this area, since high PM-10 levels are attributable to fugitive dust. Attention will be paid to defining the source receptor relationships as accurately as possible. The MAG PM-10 Source Attribution and Deposition Study, being conducted June 2006 through May 2007, will be particularly helpful in this regard. The Study consultants will assemble emissions and meteorology data for the Salt River Area on the design days to be modeled with AERMOD. All assumptions and justifications will be described in the Technical Support Document.

AERMOD requires two types of inputs, emissions and meteorological data. The emissions are input as gridded data (area, mobile and non-road) and point source data. Each source can be treated explicitly in AERMOD by providing information such as the type of source, pollutant emission rate, and source dimension. Day specific emissions data will be prepared for input to AERMOD.

2.1.2 Rollback

Although AERMOD is an appropriate choice for modeling PM-10 in the Salt River Study Area, where the meteorology is complex and the emission sources are numerous, the proportional rollback model is a more appropriate approach for areas that have a small number of exceedances and more easily-defined sources.

On January 24, 2006, winds traveling over vacant disturbed land surrounding the Higley monitor caused an exceedance of the PM-10 standard. MAG is recommending that the proportional rollback model be used to demonstrate attainment of the PM-10 standard at the Higley monitor on January 24, 2006. Since only one exceedance occurred during the period March 2005 through March 2006 and the sources can be more easily identified, rollback is a more appropriate model for modeling the Higley site.

The proportional rollback model assumes that there is a linear relationship between PM-10 emissions and concentrations. The rollback model was used successfully to demonstrate attainment in the EPA-approved Serious Area PM-10 Plan for Clark County, Nevada[6].

Although it is not one of the EPA preferred models for PM-10 attainment demonstrations, the proportional rollback model is an appropriate technique if the significant sources responsible for the high PM-10 concentrations and background PM-10 concentrations can be accurately specified. According to Clark County, the rollback model used in their Serious Area PM-10 Plan has the following characteristics[6]:

Advantages

- Appropriate for representing fugitive dust
- No meteorological data is required
- Considers all PM-10 sources within the microscale area surrounding the monitor

Disadvantages

- Sources outside the microscale area are excluded
- Control factors are not considered outside the microscale area
- Secondary particulates are not addressed.

Since the exceedances of the 24-hour standard on the design day at the Higley monitor is due to fugitive dust, not secondary particulates, rollback is an appropriate technique. The fact that rollback does not address sources outside the modeling domain can be rectified by careful specification of background concentrations. If the PM-10 concentrations at the edges of the HIgley modeling domain cannot be deduced from other sources, additional saturation monitoring may be performed. This will ensure that the background levels are adequately characterized for the purposes of rollback modeling. The fact that control factors are not considered outside the microscale area is not a critical drawback, since control measures would be implemented on a region-wide basis.

The inputs to the rollback model include a day specific emissions inventory for the modeling domain and air quality monitoring data. The modeling domain for rollback will initially be defined as a 2 km x 2 km area surrounding the Higley monitor. This domain size will be expanded if it is determined that significant sources of PM-10 are located outside this domain. Examination of aerial and satellite imagery and meteorological data will be performed to identify the significant sources contributing to the exceedance at the Higley monitor. The development of modeling emissions inventories are described in the next section.

2.2 Emissions Inventories

In the Maricopa County nonattainment area, PM-10 is largely produced by re-entrained paved and unpaved road dust, vacant disturbed areas, agricultural and construction activities, and wind blown dust[3]. For the Five Percent Plan, inventories quantifying the emissions from these sources need to be developed for two different, but important, purposes. Design day specific inventories are needed to model attainment at individual monitors with AERMOD and rollback. In addition, annual average daily emissions for the years 2007, 2008, and 2009 emissions inventories are needed to show that committed control measures will achieve a five percent per year reduction in emissions between 2007 and 2009. The modeling and annual average daily emissions inventories are discussed below.

2.2.1 Modeling Inventories

To model the impact of localized emission sources on ambient concentrations of PM-10, many state agencies and research organizations have used a day specific micro-inventory approach[2,7]. For the Five Percent Plan, design day emission inventories will be developed for the Salt River Study Area and the modeling domain surrounding the Higley monitor. The boundaries for these modeling domains are discussed in a following section.

In general, the major sources of PM-10 emissions in the Maricopa County nonattainment area include vehicular traffic, vacant lots, unpaved shoulders, and agricultural, construction, and industrial activities. AERMOD-ready gridded hourly emissions will be developed for all known sources of PM-10 in the Salt River Study Area for December 11-13, 2005. Daily emissions will be estimated for the known sources of PM-10 in the modeling domain surrounding the Higley monitor on January 24, 2006.

The base case modeling inventories will utilize data from the Maricopa County 2005 periodic emissions inventory for PM-10, the ADEQ Salt River Area PM-10 Study, and the MAG PM-10 Source Attribution and Deposition Study. The latest population estimates, land use data, and road networks will also be used.

EPA's MOBILE6.2 model will be applied to derive PM-10 emissions factors for exhaust, brake wear, and tire wear emissions. EPA's AP-42 will be applied to calculate the PM-10 emission factors for unpaved roads. Local data being collected as part of the MAG Silt Loading Study by the University of California, Riverside, College of Engineering, Center for Environmental Research and Technology (CE-CERT) will be utilized to develop paved road emission factors. The justification for use of these factors, rather than AP-42, will be included in the Technical Support Document for the Five Percent Plan. These locally-derived factors will be applied to vehicle travel estimates produced by the MAG transportation models to estimate paved road emissions.

To develop base case emissions for input to the rollback model, emissions inventories specific to the sources and design day for the modeling domain surrounding the Higley monitor will be developed. To the extent possible, the emissions for the Higley modeling domain will represent PM-10 generation activities that occurred on January 24, 2006.

For AERMOD, hourly emissions profiles will be built for the PM-10 sources in the Salt River Study Area. After the hourly emissions profiles are built, the files will be input to the M6Link program developed by MAG. M6Link is a MAG program written in FORTRAN that converts land use and traffic data to hourly emission rates and scalars for the grid cells that will surround each of the monitoring sites. The output of M6Link, PM-10 emissions ($g/s/m^2$) for each cell, will be merged with a file of PM-10 emissions from industrial point sources to produce the file that will be input to AERMOD to estimate ambient PM-10 levels.

Maps showing the spatial surrogates used to apportion emissions into the modeling grids and emission density plots of significant source categories will be included in the Technical Support Document. The percent contribution from each modeled source category will also be provided for the peak modeling concentrations.

To demonstrate attainment, the base case emissions inventories for the design days will be adjusted to reflect emissions expected to occur in 2009. The general methodology for creating the 2009 base case emissions will follow EPA guidance on the preparation of emission projections[10]. These adjustments will entail the use of growth factors, ongoing control programs, and retirement rates for obsolete sources of emissions. The growth factors used to create the 2009 base case inventories will represent the latest socioeconomic projections approved by MAG.

Additional control measures will be evaluated using the 2009 base case emissions and AERMOD or rollback models. The 2009 emissions inventories with committed control measures will be used to demonstrate attainment of the PM-10 standard at the Durango Complex, Higley, and West 43rd Avenue monitors.

2.2.2 Five Percent Inventories

In addition to modeling attainment at the monitors that exceed the 24-hour PM-10 standard, the Five Percent Plan must show a five percent reduction in emissions per year until the PM-10 standard is achieved. According to Section 189(d) of the Clean Air Act, the emissions inventory to be used in meeting this requirement must represent the year that the plan is due to EPA. Since MAG will submit the Five Percent Plan to EPA by December 31, 2007, a 2007 PM-10 emissions inventory for an annual average day will be developed.

In order to show a five percent reduction from 2007 to 2008, and 2008 to 2009, emissions inventories must also be developed for 2008 and 2009. The 2007, 2008 and 2009 base case emissions will be “grown” from the 2005 periodic emissions inventory for PM-10 prepared by the Maricopa County Air Quality Department. All sources of PM-10 emissions will be included in these inventories. The 2007, 2008 and 2009 annual average daily emissions inventories will represent the entire PM-10 nonattainment area.

The general methodology for creating the 2007, 2008 and 2009 base case emissions inventories will follow EPA guidance on the preparation of emissions projections[10]. These adjustments will entail the use of growth factors, ongoing control programs, and retirement rates for obsolete sources of emissions. The growth factors used to create these inventories will reflect the latest socioeconomic projections approved by MAG.

Emissions reduction credit for new and strengthened PM-10 control measures will be applied to reduce 2007 base case PM-10 emissions by at least five percent per year until the attainment year of 2009. This means that 2009 emissions with new and strengthened control measures must equal 90 percent or less of total 2007 emissions.

The onroad mobile source component of the 2009 emissions with committed control measures will provide the basis for a new PM-10 conformity budget. The PM-10 sources contributing to this budget will include exhaust, tire wear, and brake wear emissions, as well as fugitive emissions from paved roads, unpaved roads, and road construction.

2.3 Meteorological Data

AERMET is a general purpose preprocessor for organizing available meteorological data into a format suitable for use by the AERMOD air quality dispersion model. AERMOD requires meteorological data in order to model pollutant concentrations and deposition. Table 2-1 provides the necessary meteorological parameters for PM-10 concentration and deposition evaluation[8].

Meteorological data for the design days of December 11-13, 2005 for the Salt River Study Area will be based on the wind, temperature and surface pressure measurements collected at monitoring sites in the area. Surface data can be obtained from the National Climate Data Center (NCDC), SCRAM web site, SAMSON surface data AriZona METeorological network (AZMET), and monitor specific meteorology data. The upper air station data for meteorological modeling will be derived from the FSL (Forecast Systems Laboratory) stations shown in Table 2-2. Upper air sounding data will be obtained from the Tucson Airport taken at 5 a.m. and 5 p.m. on each of the design days. Any missing data will be supplemented using either NCDC or SCRAM meteorological data. Site and day specific meteorological data are provided in Attachment I.

Table 2-1 Required Meteorological Information

	Meteorological Data		
Surface Hourly Data	**Units**	**Concentration**	**Dry Deposition**
Wind Speed	Knots	X	X
Wind Direction	tens of degrees	X	X
Ambient air temperature	F	X	X
Opaque Cloud Cover	tenths	X	X
Station pressure	millibars		X
Daily Upper Air Data		X	X
Morning Mixing Height	m	X	X
Afternoon Mixing Height	m	X	X

Table 2-2 Meteorological Monitoring Stations

NWS (33 sites)								
Site	**Abbr.**	**Lat**	**Lon**	**UTM (Zone 12)**		**Elev. (m)**	***Address***	**County**
				Northing (m)	**Easting (m)**			
Casa Grande Municipal Airport	KCGZ	32.95000	-113.76389	3646004.74	428339.63	446	510 E. FLORENCE BLVD, Casa Grande	Pinal
Chandler Municipal Airport	KCHD	33.26917	-113.93306	3681421.13	424459.38	379	2380 S. STINSON WAY, Chandler	Maricopa
Davis-Monthan Air Force Base	KDMA	32.16667	-111.44806	3558916.01	511000.13	824	DAVIS-MONTHAN AFB, Tucson	Pima
Douglas Bisbee International Airport	KDUG	31.46917	-112.42222	3482443.65	632656.74	1266	1415 MELODY LANE, BLDG C, Douglas Bisbee	Cochise
Phoenix Deer Valley Municipal Airport	KDVT	33.69028	-110.72083	3728325.15	401239.94	450	702 W DEER VALLEY DR, Phoenix	Maricopa
Tucson NEXRAD	KEMX	31.88300	-110.00556	3527531.19	536222.38	1586	Tucson	Pima
Mesa/Falcon Field	KFFZ	33.46667	-109.37917	3703264.45	431857.54	424	4800 FALCON DR, Mesa	Maricopa
Flagstaff	KFGZ	36.21700	-111.67222	4008326.71	426567.23	2192	Flagstaff	Coconino
Libby AAF Fort Huachuca	KFHU	31.60000	-111.81700	3496292.91	563243.03	1438	401 GIULIO CESARE AVE, Sierra Vista	Cochise
Flagstaff Pulliam Airport	KFLG	35.14028	-112.15472	3888806.53	438763.21	2137	6200 S. PULLIAM DR, 204, Flagstaff	Coconino
Flagstaff NEXRAD	KFSX	34.56700	-114.55944	3825044.89	481654.04	2260	Flagstaff	Coconino
Gila Bend U.S. Army Airfield	KGBN	32.43333	-112.68333	3589715.73	341743.08	262	Gila Bend	Maricopa
Grand Canyon National Park Airport	KGCN	35.94611	-110.61700	3978587.39	395854.86	2014	Grand Canyon	Coconino
Glendale Municipal Airport	KGEU	33.52722	-112.38333	3710488.09	379721.07	325	6801 N. GLEN HARBOR BLVD 201, Glendale	Maricopa
Goodyear Municipal	KGYR	33.41667	-110.84583	3698335.76	371380.94	295	1658 SO LITCHFIELD RD, Goodyear	Maricopa
Laughlin/Bullhead International Airport	KIFP	35.15750	-110.33333	3893236.68	722300.40	212	2550 LAUGHLIN VIEW DR, Bullhead City	Mohave
Kingman Airport	KIGM	35.25778	-109.60361	3905575.22	233156.32	1050	7000 FLIGHTLINE DR, Kingman	Mohave
Winslow Municipal Airport	KINW	35.02806	-110.95528	3876190.43	525466.06	1505	21 WILLIAMSON AVE, Winslow	Navajo
Mesa Williams Gateway Airport	KIWA	33.31660	-109.63556	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Williams AFB/Chandler	KIWA	33.31667	-111.76667	3686574.65	439496.98	421	6001 SOSSAMAN RD, Mesa	Maricopa
Luke Air Force Base/Phoenix	KLUF	33.53333	-111.81111	3711271.17	371553.24	332	LUKE AFB, Glendale	Maricopa
Yuma Marine Corps Air Station	KNYL	32.62361	-109.06667	3612935.22	240675.79	64	Yuma	Yuma
Nogales International Airport	KOLS	31.42083	-111.73333	3476252.27	514652.98	1198	Nogales	Santa Cruz
Page Municipal Airport	KPGA	36.92056	-112.06556	4086153.63	460091.83	1314	697 VISTA AVENUE, Page	Coconino
Phoenix Sky Harbor International Airport	KPHX	33.43417	-111.65000	3699914.60	402291.25	345	3400 SKY HARBOR BLVD, Phoenix	Maricopa
Prescott Love Field	KPRC	34.64917	-111.65000	3835058.29	369663.82	1537	6546 CRYSTAL LANE, Prescott	Yavapai
Wind Rock Airport	KRQE	35.65000	-112.29528	3946850.91	675023.86	2055	Window Rock	Apache
Safford Municipal Airport	KSAD	32.85722	-111.91056	3636283.38	627670.20	968	4550 E AVIATION WAY, Safford	Graham
Scottsdale Airport	KSDL	33.62278	-114.60000	3720703.49	415540.50	460	15000 N AIRPORT DR, Scottsdale	Maricopa
St. Johns Industrial Airpark	KSJN	34.51833	-111.20000	3820822.44	648772.04	1747	St. Johns	Apache
Show Low Regional Airport	KSOW	34.26528	-110.88333	3792017.67	591549.62	1955	3150 AIRPORT LOOP, Show Low	Navajo

Tucson International Airport	KTUS	32.13139	-112.05111	3555000.31	504218.01	805	Tucson	Pima
Yuma International Airport	KYUM	32.65000	-112.38333	3615031.47	725106.73	65	2191 E 32ND ST, Yuma	Yuma

AZMET (23 sites)

Site	Abbr.	Lat	Lon	UTM (Zone 12) Northing (m)	UTM (Zone 12) Easting (m)	Elev. (m)	***Address***	County
Aguila	AGUI	33.946667	-113.188889	3758401	297716	655	0.6 Miles NW of Aguila City Limits	Maricopa
Bonita	BONI	32.463611	-109.929444	3592330	600610	1346	18 Miles N on Rex Allen Dr from Willcox at I-10	Graham
Buckeye	BCK1	33.400000	-112.683333	3696899	343454	304	3.5 km S of Exit 109 from I-10	Maricopa
Coolidge	COOL	32.980000	-111.604722	3649232	443496	422	0.8 km SW of the Curry Rd & Bechtel	Pinal
Eloy	ELOY	32.773889	-111.556944	3626358	447840	461	0.8 km E of 11 Miles Corner Rd on Arica Rd	Pinal
Harquahala	HARQ	33.483333	-113.116667	3706876	303337	350	1.8 km N of the Intersection of Courthouse Rd & 491st Ave	Maricopa
Laveen	LAVE	33.376389	-112.150000	3693605	393027	315	3921 W Baseline Rd	Maricopa
Litchfield	LITC	33.467222	-112.398056	3703959	370087	309	1 Mile N of McDowell Rd on Cotton Ln	Maricopa
Marana	MARA	32.461111	-111.233333	3591572	478071	601	1 Mile W of I-10 on Trico-Marana Rd	Pima
Maricopa	MARI	33.068611	-111.971667	3659313	409299	361	NW corner of field #5 S of Irrigation Lab Building	Pinal
Mohave	MOHA	34.967222	-114.605833	3872026	718581	146	14.2 Miles S of Bullhead City on AZ Route 95	Mohave
Paloma	PALO	32.926667	-112.895556	3644751	322765	219	9 Miles W of Gila Bend on I-8 to Paloma Exit	Maricopa
Parker	PARK	33.882778	-114.447778	3752091	736045	94	8 Miles S of Poston & 0.4 Miles E on Nez Rd	La Paz
Phx. Encanto	ENCA	33.479167	-112.096389	3704947	398135	335	SE of Thomas Rd & 19th Ave (Encanto Golf Course)	Maricopa
Phx. Greenway	PGRN	33.621389	-112.108333	3720728	397193	401	SE of Greenway & 23rd Ave (Cave Creek Golf Course)	Maricopa
Queen Creek	QUEE	33.258333	-111.641667	3680110	440233	430	0.1 km E of Queen Creek Rd & Ellsworth Rd	Maricopa
Roll	ROLL	32.744444	-113.961111	3626837	222539	91	County 4th St & Ave 39 E	Yuma
Safford	SAFF	32.813333	-109.678333	3631367	623729	901	0.8 km SE of Lone Star Rd & Mountain Rd	Graham
Tucson	TUCS	32.280278	-110.945833	3571504	505101	713	1 km NW of Campbell Ave & Roger Rd	Pima
Waddell	WADD	33.618056	-112.459722	3720763	364592	407	2 Miles W of Cotton Ln & 0.4 Miles S of Greenway Rd	Maricopa
Yuma Mesa	YMES	32.611944	-114.633889	3610740	722021	58	0.32 km W of Ave A on 15th St	Yuma
Yuma North Gila	YUMA	32.735278	-114.529444	3624641	731506	44	2.1 km W on 7th Ave from Gila Center	Yuma
Yuma Valley	YVAL	32.712500	-114.705000	3621744	715106	32	5 Miles W of Yuma on 8th St	Yuma

FSL (4 sites)

Site	Abbr.	Lat	Lon	UTM (Zone 12) Northing (m)	UTM (Zone 12) Easting (m)	Elev. (m)	Address	County
Flagstaff/Bellemt	FGZ	35.23	-111.82	3898858	425383	2179	123 miles North from Central Phoenix	Coconino
Tucson	TUS	32.12	-110.93	3553739	506603	788	113 miles South from Central Phoenix	Pima
Yuma/US Army	YUM	32.87	-114.33	3640036	749823	131	138 miles West from Central Phoenix	Yuma
Yuma/US Army	1Y7	32.87	-114.40	3639872	743271	98	142 miles West from Central Phoenix	Yuma

Attachment V provides the weather map information for all four design days. Additional meteorology data will be collected in the Salt River Study Area by the MAG PM-10 Source Attribution and Deposition Study during November and December of 2006.

Surface pressure along with surface roughness length, non-time albedo, bowen ratio, anthropogenic heat flux and fraction of net radiation absorbed at the ground are the main meteorological parameters used for the dry deposition calculation in AERMOD[7]. Surface roughness length is a measure of the height of obstacles to the wind flow. A surface roughness length representative of either measurement site or facility site can be used. Noon-time albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. AERMET has standard tables representing different land use types and various seasons. Bowen ratio is a measure of the amount of moisture at the surface. Like the albedo, the bowen ratio has three different tables depending on the land use type, different seasons and various (dry, average and wet) conditions. Anthropogenic heat flux (W/m^2) is the surface heating caused by human activity, including automobiles and heating systems. EPA recommends that a value of 0.0 W/m^2 and 20 W/m^2 be used for rural and large urban areas, respectively. The flux of heat into the ground during the daytime is parameterized as a fraction of net radiation. EPA recommends values of 0.15 for rural and 0.27 for urban areas.

The choice of meteorological data to be used to model the Salt River Area will take into consideration the availability and accuracy of meteorological data for December 11-13, 2005; meteorology at the monitors with the highest PM-10 concentrations during this period (i.e., West 43rd Avenue and Durango Complex); and the wind speeds and directions that best simulate the transport of emissions during the modeled event. The PM-10 Source Attribution Study will also provide insights as to the appropriate meteorology to be used as inputs to AERMOD.

2.4 Modeling Domains

The AERMOD modeling domain (Salt River Study Area) is shown in Figure 2-1. This area was initially defined in the ADEQ Salt River Area PM-10 Study[2]. The highest PM-10 readings are typically recorded at the monitors in this area. There are four PM-10 monitors in the Salt River Study Area: Bethune Elementary, Durango Complex, South Phoenix, and West 43rd Avenue. MAG proposes to apply AERMOD to the Salt River Study Area for the period December 11-13, 2005 (stagnant conditions). The Durango Complex, Greenwood, West 43rd Avenue, and West Phoenix monitors exceeded the PM-10 standard on December 12. In addition, the Durango and West 43rd sites exceeded on December 13. The Greenwood monitor is located two blocks north, and the West Phoenix monitor, two miles north, of the Salt River Study Area. On December 12, the Durango and West 43rd monitors had higher readings (i.e., 206 and 233, respectively) than Greenwood and West Phoenix (i.e., 172 and 155, respectively).

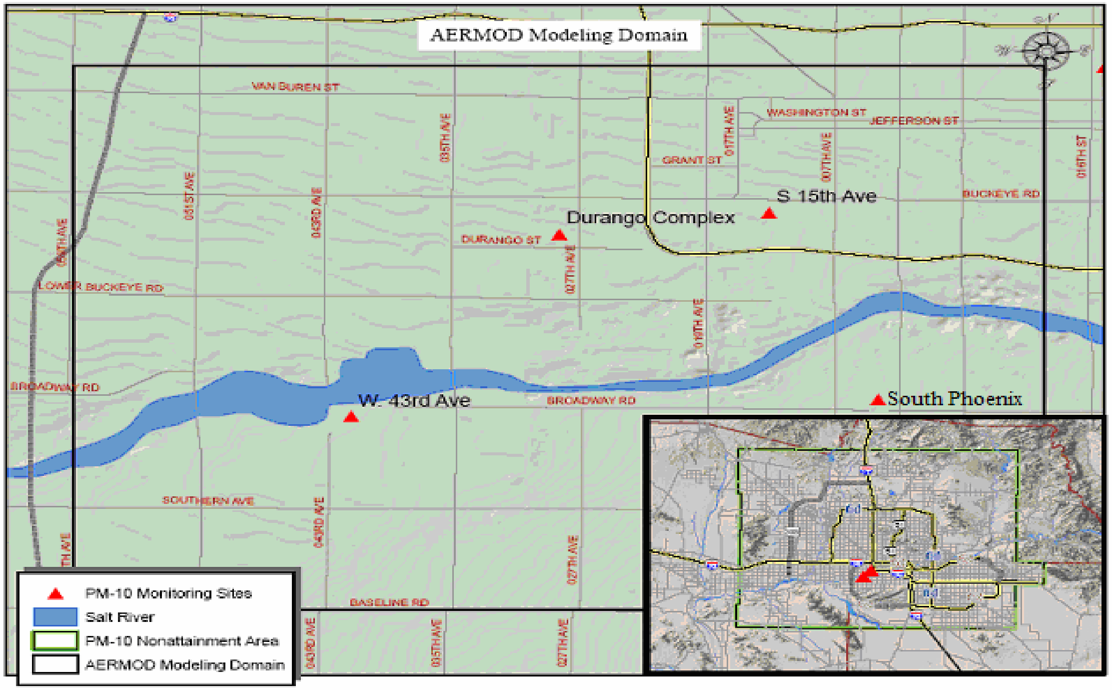

Figure 2-1 Salt River Study Area

Due to the diversity and number of PM-10 sources in the Salt River Area, this area is considered to be a worst-case representation of sources throughout the nonattainment area. This area has the highest density of PM-10 emissions in the nonattainment area. In addition, all major sources of PM-10 emissions, except unpaved roads, are represented in the area. These sources include: light and heavy dust-generating industries, active agricultural land, active construction sites, vacant lots, and unpaved parking areas. The area also includes four monitors, two of which typically record the highest PM-10 concentrations in the nonattainment area.

Preliminary analyses of monitoring data from the Durango and West Phoenix sites during January and February 2006 indicate that the ratio of PM-2.5 to PM-10 at these two continuous monitors remains relatively constant over the day. This suggests that the high readings at these two monitors are attributable to similar sources. The MAG PM-10 Source Attribution and Deposition Study will confirm this finding through saturation monitoring during November and December 2006. The Technical Support Document will describe the source mix around the Greenwood and West Phoenix monitors and will demonstrate that regionally implemented control measures will eliminate the small number of exceedances at these two monitors north of the Salt River Area. The TSD will provide convincing evidence that attainment of the PM-10 standard within the Salt River Area will also result in attainment at the Greenwood and West Phoenix monitors.

While ADEQ used 400 m grids to model the Salt River Study Area, MAG will consider using a smaller size if the MAG PM-10 Source Attribution and Deposition Study recommends this adjustment. The Study will update the PM-10 emissions inventory for the area and perform additional meteorological and particulate matter monitoring during the fall of 2006. A recommendation to reduce the grid size for AERMOD modeling could result from the emissions inventory update and saturation monitoring.

For rollback modeling, a domain of 2 km by 2 km surrounding the Higley monitor is proposed. There is significant acreage of vacant disturbed land adjacent to the Higley monitor that is likely to be the primary source of PM-10 emissions that caused the single exceedance at this monitor.

Prior studies performed by ADEQ and Clark County, Nevada, will be examined to determine the distance of influence for PM-10 sources. In addition, field work being performed by the MAG PM-10 Source Attribution and Deposition Study in the fall of 2006 will provide additional insights into PM-10 deposition rates in the nonattainment area. The size of the modeling domain for the Higley monitor may be increased if these studies and/or aerial and satellite imagery and meteorological data indicate that there are significant contributing sources outside of the 2 km x 2 km modeling area.

The rollback modeling domain for Higley is illustrated in Figure 2-2. Attachment II discusses the domain selection process.

2.5 Design Day Selection

A detailed description of the design day selection process is provided in Attachment I. The primary criteria applied in selecting the design days for PM-10 modeling were:

- Days with high 24-hour PM-10 concentrations that are close to the design value for each monitor
- Availability of the air quality, emission and meteorological data for the selected days and episode

The Durango Complex and West 43rd Avenue monitors are located about two miles apart, to the north and south, respectively, of the Salt River. These two monitors consistently record the highest PM-10 concentrations in the nonattainment area. The Durango and West 43rd monitors exceeded the 24-hour PM-10 standard on 20 and 22 days, respectively, between March 2005 and March 2006. Sixteen of the exceedances at Durango and West 43rd occurred on the same day. Most of the exceedances occurred during the fall and winter of 2005-2006 under low wind and severe inversion conditions.

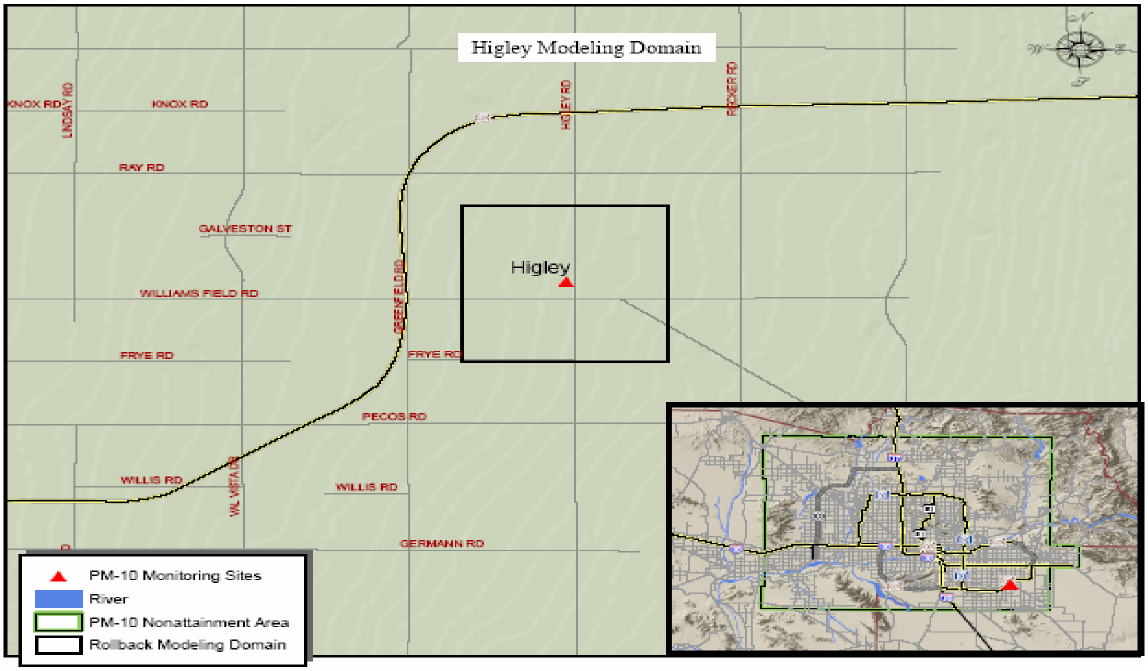

Figure 2-2 Rollback Modeling Domain for Higley

December 11-13, 2005 have been selected as the dates to be modeled with AERMOD to represent these stagnant conditions. On December 12, the West 43rd Avenue monitor recorded a 24-hour PM-10 concentration of 233 ug/m^3, while Durango Complex was 207 ug/m^3. On December 13, the West 43rd Avenue monitor 24-hour reading at West 43rd Avenue was 167 ug/m^3; Durango was 166 ug/m^3. December 11 will be modeled as a spin-up day.

On March 10, 2006, the West 43rd Avenue monitor recorded the highest PM-10 concentration at this monitor of 260 μ/m^3. The exceedance was caused by the prevalence of high winds for many hours; the average wind speed for the day was 9 mph. Durango (240 μ/m^3) and Greenwood (166 μ/m^3) also experienced exceedances on this day. However, ADEQ has advised MAG that the PM-10 readings on this day have been flagged as a natural event due to high winds. Therefore, this day will not be modeled for the Five Percent Plan.

Other monitors that exceeded the PM-10 standard between March 2005 and March 2006 were Buckeye and Higley. Although the Buckeye monitor had five exceedance days during this period, the monitor is located outside of the western boundary of the PM-10 nonattainment area and therefore, will not be modeled for the Five Percent Plan.

During the period March 2005 through March 2006, the Higley monitor exceeded the 24-hour PM-10 standard only once, on January 24, 2006. Windy conditions on this day caused disturbed vacant lands in the vicinity of the monitor to emit PM-10. To ensure that this monitor does not violate the PM-10 standard in the future, it is proposed that the area surrounding the Higley monitor be modeled with rollback on January 24, 2006.

In summary, the proposed design days and models for the Five Percent Plan are:

- December 11-13, 2005 (low wind) - AERMOD
- January 24, 2006 (high wind) - Rollback

December 11-13, 2005 are low wind days with significant inversion conditions. December 12 had the highest 24-hour PM-10 average of 233 μ/m^3 at West 43rd Avenue and 207 μ/m^3 at Durango Complex. The Greenwood and West Phoenix monitors also recorded exceedances on this day of 173 and 155 μ/m^3, respectively.

On January 24, 2006, only the Higley monitor experienced an exceedance with a 24-hour concentration of 170 μ/m^3. Meteorological analysis indicates persistence of a few hours of high winds on this day.

2.6 Ambient Monitoring Data

Air quality monitoring networks operate in urban and rural areas throughout Arizona. ADEQ and MCAQD continually monitor and assess air quality in the metropolitan centers and in the remote areas of the state. There are total of 20 PM-10 monitoring stations; 15 are maintained by MCAQD and 5, by ADEQ. Table 2-3 lists and Figure 2-3 illustrates the locations of the PM-10 monitoring sites in Maricopa County. Maricopa County uses a combination of one-in-six day filter based monitors and continuous TEOMs, whereas ADEQ uses DICHOT sampling techniques. The Chandler, Central Phoenix, Glendale, South Phoenix, South Scottsdale, and West Phoenix stations are part of the National Air Monitoring Stations (NAMS) network and the remainder are part of the State and Local Air Monitoring Stations (SLAMS) network.

Air quality monitoring data provides multiple inputs to air quality models. First, the data indicate where there are exceedances of the standard. Second, the data provide background concentrations that are used in modeling future attainment. Third, the data allow the assessment of modeling performance in simulating base year PM-10 concentrations.

This protocol considers the monitoring data from March 2005 through March 2006, because this represents the period when exceedances occurred that will prevent the area from attaining the 24-hour PM-10 standard by December 31, 2006. Analysis of data from this period indicates that 30 exceedance days occurred in the nonattainment area. Twenty-four of these exceedance days occurred at the West 43rd Avenue and/or Durango Complex monitors.

Saturation monitoring to be performed as part of the MAG PM-10 Source Attribution and Deposition Study during the fall of 2006 will assist in quantifying the contribution of the urban transport component to PM-10 concentrations in the Salt River Study Area. Monitoring data from pristine locations such as Organ Pipe National Monument will be utilized to identify the rural background component of the PM-10 transported into the area.

The monitoring data indicate that the PM-10 in the nonattainment area is primarily coarse material emitted by primary sources. Co-located PM-10 and PM-2.5 monitors at Durango Complex indicate that PM-2.5 concentrations are typically 14 to 22 percent of the monitored PM-10 concentrations on low wind days that exceeded the 24-hour standard. On high wind exceedance days, the PM-2.5 concentrations ranged from 6 to 15 percent of the 24-hour PM-10 concentrations. The highest 24-hour average PM-2.5 concentration in 2006 of 38.5 $\mu g/m^3$ was observed at Durango Complex on a low wind day, February 9, 2006. This value is slightly higher that the new 24-hour PM-2.5 standard of 35 $\mu g/m^3$, but does not constitute a violation of the standard.[2] This monitoring data confirms that the high PM-10 concentrations in the nonattainment area are caused primarily by fugitive dust emissions from primary, not secondary, sources. Attachment I provides a more detailed analysis of ambient monitoring data for PM-10.

Table 2-3 PM-10 Monitoring Sites in Maricopa County

Site Name	Operator	Location
Buckeye*	MCAQD	Hwy 85 & MC 85
Chandler	MCAQD	1475 E. Pecos Road
Central Phoenix*	MCAQD	1845 E. Roosevelt Street
Durango Complex*	MCAQD	2702 AC Esterbrook
Dysart	MCAQD	Dysart Road & Bell Road
Glendale	MCAQD	6000 W. Olive Avenue
Greenwood	MCAQD	27th Avenue/I-10
Higley*	MCAQD	15500 S. Higley Road
Mesa	MCAQD	Broadway & Brooks
North Phoenix	MCAQD	601 E. Butler Road
South Phoenix	MCAQD	4732 S. Central Avenue
South Scottsdale	MCAQD	2857 N. Miller Road
West Chandler	MCAQD	163 S. Price Road
West 43rd Ave*	MCAQD	3940 W. Broadway Road
West Phoenix*	MCAQD	3847 W. Earll Drive
Bethune Elementary	ADEQ	1310 S. 15th Avenue
Goodyear /Estrella	ADEQ	15099 W. Casey Abbott Drive
JLG Super Site	ADEQ	4530 N. 17th Avenue
Palo Verde	ADEQ	36248 W. Elliot Road
Tempe	ADEQ	3340 S. Rural Road

*Continuous TEOM monitors in Maricopa County

[2] A violation of the standard occurs when the three year average of the 98th percentile value is greater than 35 μ/m^3.

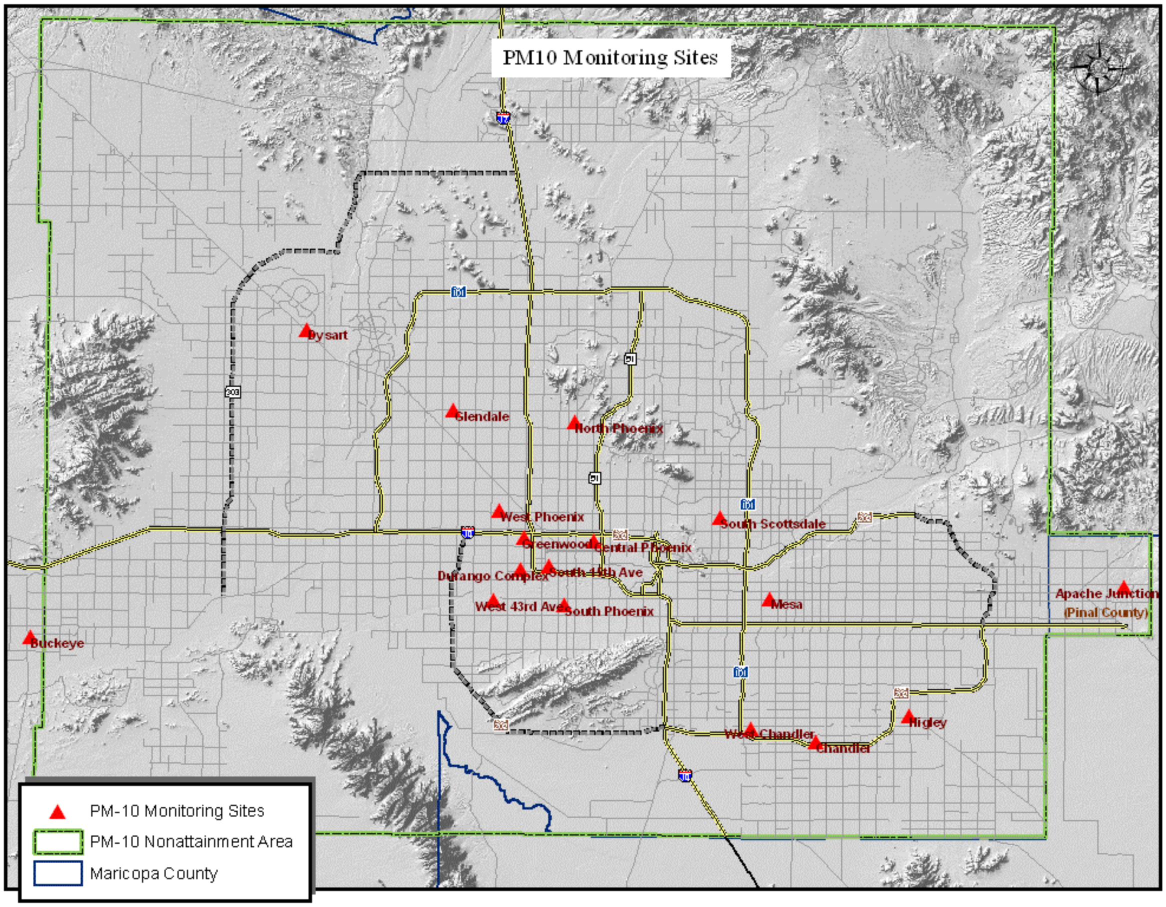

Figure 2-3 PM-10 Monitoring Sites In or Near the Maricopa County PM-10 Nonattainment Area

2.7 Design Value Determination

The design value is based on the highest short-term concentration over a multi-year period. Table 2-4 provides the design values for PM-10 monitors in Maricopa County, where the design value represents the highest PM-10 concentration over the period 2003 through 2005, excluding natural events. Monitors missing from the table did not have three years of valid data.

Design values will be recalculated for 2004-2006 when verified 2006 monitoring data are available. Refer to http://www.maricopa.gov/aq/status/REVIEW05.pdf for the latest information on PM-10 monitoring conducted by Maricopa County.

Table 2-4 Design Values for Maricopa County PM-10 Monitors (in $\mu g/m^3$)

Site Name	Design Value	2003	2004	2005
Chandler	240	240	150	130
West Chandler	206	206.1	70	94
Glendale	150.5	150.5	69.1	84.4
Higley	224.9	224.9	~492.6	142
Mesa	176.4	176.4	49	85.5
Durango Complex	206.9	195.2	~208.7	206.9
South Phoenix	164.3	164.3	132.3	147.3
West 43rd Ave	233.1	156.7	~251	233.1
West Phoenix	157.5	157.5	100.1	155
Central Phoenix	124.9	113.9	55.5	124.9
North Phoenix	155	155	46.3	80.8
Greenwood	172.7	166.1	100.1	172.7
South Scottsdale	172.4	172.4	77	120.7

~ Indicates Natural or Exceptional Events

It is interesting to note, with the exception of the Durango Complex, West 43rd Avenue, and Greenwood monitors, the design values are based on the highest 24-hour concentration recorded in 2003. This suggests that the general trend in PM-10 emissions may be decreasing except at the monitoring sites in the Salt River Area.

3. AERMOD Performance Evaluation

EPA has instituted formal evaluation criteria for Gaussian dispersion models such as AERMOD[1,11]. The guidelines for air quality models suggest a three-step evaluation procedure. First, the procedure should show how the modeling is used. Second, it should guide the use of statistical performance measures, including measures of difference such as bias, variance and gross variability of the difference, and correlation measures such as time, space, and time and space combined. Third, more information should be provided for justifying the site-specific use of alternate models. In addition, sensitivity analysis is encouraged since these analyses provide information on the effect of inaccuracies in the databases and the uncertainties in model estimates.

Model performance data will be provided for all of the AERMOD-modeled monitors for all design days. The rule of thumb in the modeling community is that any AERMOD prediction within a factor of two of the measurements is acceptable. Simulated and observed 24-hour average PM-10 concentrations at each monitoring station for the two design days will be plotted with wind speed and direction.

Scatter plots of predicted versus observed PM-10 concentrations will be provided in order to determine the accuracy of model estimation. The scatter of the points, diverging in many cases far from the 1:1 line, indicates that the model is not simulating the measurements accurately. Each point represents a paired model prediction (model concentration plus background) and measurement, averaged for one hour. Regression statistics will be performed to determine the regression coefficient, slope and intercept. Hourly time series plots will be developed for each design day for each site, comparing predicted (background and model concentration) with observed concentrations. This is a viable measure since the available monitoring data is continuous. This will be very useful in determining how accurate the model is predicting by hour. Another way to present these data is to plot the measurements from their highest to lowest value as a single line, and to plot the paired model prediction as a separate line.

4. Attainment Demonstration

4.1 Identification of Attainment Year

Because of numerous exceedances of the standard in 2006, the earliest date that attainment can be achieved at PM-10 monitors in the Maricopa County nonattainment area is December 31, 2009. The primary purpose of air quality modeling with AERMOD and rollback is to show that attainment of the 24-hour PM-10 standard will be achieved by this date in the modeling domains. Attainment will be modeled based on emission reductions attributable to commitments contained in the Five Percent Plan. These commitments may represent new control measures or a strengthening of existing measures in the Serious Area PM-10 Plan[9].

4.2 Identification of Control Measures

The committed measures already implemented in the Serious Area PM-10 Plan[9] will be assumed in the 2009 base case modeling inventory. These committed measures will also be in the 2007, 2008, and 2009 base case emissions inventories to be used in meeting the five percent per year requirement. Additional measures that are needed to model attainment and achieve five percent per year reductions in emissions will be submitted to the MAG Air Quality Technical Advisory Committee for consideration as part of the Suggested List of Measures. Following Regional Council approval of the Suggested List of Measures, the local jurisdictions and the Legislature will be requested to consider the implementation of the measures under their respective authorities. Each jurisdiction determines which measures are feasible for implementation by that jurisdiction. These measures then become committed measures in the Five Percent Plan.

Emissions reductions attributable to the commitments received from implementing entities will be estimated based on the latest available information from EPA and other sources (e.g., the WRAP Fugitive Dust Handbook). These reductions will be incorporated into the 2009 modeling for the selected design days. Based upon model output, it will be determined if the control measures demonstrate attainment of the 24-hour PM-10 standard. The committed measures will also be applied to the 2008 and 2009 base case emissions inventories for the PM-10 nonattainment area to show five percent per year reductions, relative to 2007 base case emissions. If additional control measures are needed to satisfy the modeling or five percent per year requirement, the process described above will be repeated.

4.3 Modeling Attainment Test

To demonstrate attainment of the 24-hour PM-10 standard in 2009, the concentrations estimated by AERMOD and rollback should not exceed 154 ug/m^3 at any monitor in the modeling domain on the selected design days. If the application of the AERMOD model for the 2005 base case results in modeled values that differ significantly from monitored concentrations, AERMOD results will be applied in a relative manner. That is, the percent change from model is applied to monitored value net of background, and then background is added back in. The background concentrations would be subtracted from the monitored value before the change is applied and would be added back in after the change is applied. The result would be compared with the 24-hour standard on the design days to determine if attainment is achieved. This is a variant of the rollback model, in which emissions and concentrations are assumed to be proportional. A similar approach was applied in the ADEQ Salt River Area Study, where modeled results using AERMOD were significantly below the monitored values.

4.4 Modeling Reliability and Uncertainties

AERMOD and rollback are considered to be appropriate tools for projecting the future air quality impact of changes in emissions. However, future year modeling results should not be considered absolute guarantees of future air quality. Uncertainties in the models used and their inputs, along with meteorological variability, may result in actual future air quality that differs from predicted air quality. Higher concentrations than those modeled may occur for any of the following reasons:

Meteorological variability - In selecting design days, the goal is to select periods that represent worst-case conditions. If episodes with more severe stagnation occur in the future, emission controls designed to reach attainment for a historical episode may not be adequate.

Emissions variability - Emission estimates are based on average source usage, taking into account seasonal, diurnal, and day-of-week factors. Nonroad and onroad mobile emissions estimates take into account day-specific temperatures as well. However, emissions on a given day may be greater than average due to greater than average usage, lower temperatures, or other factors. Uncertainty in growth projections - If growth projections underestimate true growth rates, future year emissions may be greater than projected emissions. Uncertainty in control measure effectiveness - If actual emission reductions from a given control measure are smaller than the estimated emission reductions, future concentration will be greater than modeled concentrations.

Model performance - If the model under-predicted concentrations at a particular site, or has failed to capture a particular aspect of the meteorology, then a level of emission reduction that appeared to be adequate during modeling may not actually be adequate. By similar reasoning, future measured concentrations may be lower than modeled concentrations because of these variabilities and uncertainties. In addition, future measured concentrations will still be limited to monitoring site locations. As a result, although modeled future design values below 155 μ/m^3 are adequate to demonstrate attainment, modeling results are better thought of as points on a probability distribution. If the modeled peak is very close to 155 μ/m^3, however, the probability that attainment will result may be well below 100 percent given the probabilistic nature of meteorology and modeling.

References

[1] Revisions to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, U.S. Environmental Protection Agency, Federal Register, Vol. 70, No. 216, p. 68218, November 9, 2005. (Attachment IV)

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